UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103

MEMORANDUM

DATE: November 30, 1999

SUBJ: Technical Support Document for the One-Hour Ozone Attainment Demonstration for the Pennsylvania Portion of the Philadelphia-Wilmington-Trenton Ozone Nonattainment Area (PA117-4095)

FROM: Jill Webster, Environmental Scientist Jill Webster 11/30/99
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Attached is the Technical Support Document for the One-Hour Ozone Attainment Demonstration for the Pennsylvania Portion of the Philadelphia-Wilmington-Trenton Ozone Nonattainment Area.

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I. Scope and Content of this Document

This document was prepared to document and address the adequacy of the technical procedures employed by the Commonwealth of Pennsylvania, Department of Environmental Protection (PADEP) in the completion of the ozone attainment modeling demonstration presented in the PADEP submittal entitled, **State Implementation Plan (SIP) Revision for the Philadelphia Interstate Ozone Nonattainment Area Meeting the Requirements of the Alternative Ozone Attainment Policy Phase II, April 1998.** EPA believes that the combination of local scale modeling, weight-of-evidence (WOE) demonstration presented in the Pennsylvania plan and this TSD, and additional action taken by the Commonwealth demonstrate attainment of the 1-hour ozone standard for the Philadelphia interstate ozone nonattainment area.

The Technical Support Document (TSD) is structured in the following way. Section II provides general background information regarding the Phase II Plan and the framework for which action will be taken on the submittal. Section III provides a technical description of the local scale modeling and includes discussions on model and model setup, episodes, emissions and model performance and sensitivity runs. Section IV contains discussions of the corroborating information presented in the Pennsylvania plan to support the conclusion that it is likely the Philadelphia interstate ozone nonattainment area will attain the 1-hour ozone standard by the required statutory date of 2005. Section V is the analysis of Pennsylvania's submittal against the framework for proposing action. Section VI is a summary discussion of all the information contained in the TSD, including EPA's final comments on the adequacy of the attainment demonstration. Section VII contains EPA's rulemaking recommendations regarding Pennsylvania's Phase II plan.

II. Background, General Requirements and the Framework for Approval

IIA. Clean Air Act Requirements and EPA Guidance

The Pennsylvania counties of Bucks, Chester, Delaware, Montgomery and Philadelphia are part of the Philadelphia-Wilmington-Trenton interstate ozone nonattainment area that is classified as a severe nonattainment area. The Clean Air Act set an attainment year of 2005 for severe nonattainment areas.

Section 182 of the Clean Air Act (CAA) requires that states submit state implementation plans (SIPs) by November 1994 demonstrating attainment for severe ozone nonattainment areas. The attainment plan should include a demonstration that the SIP will provide for attainment of the ozone national ambient air quality standard (NAAQS) by the applicable attainment date. The attainment demonstration must be supported by photochemical grid modeling and include sufficient reductions in ozone precursor emissions through adopted control measures necessary to support attainment of the NAAQS.

When the modeling does not conclusively demonstrate attainment, additional analyses may be presented to help determine whether the area will attain the standard. As with other predictive tools, there are inherent uncertainties associated with modeling and its results. For example, there are uncertainties in some of the modeling inputs, such as the meteorological and emissions data bases for individual days and in the methodology used to assess the severity of an exceedance at individual sites. The EPA's guidance recognizes these limitations, and provides a means for considering other evidence to help assess whether attainment of the NAAQS is likely. The process by which this is done is called a weight of evidence (WOE) determination.

Under a WOE determination, the State can rely on and EPA will consider factors such as other modeled attainment tests, e.g., a rollback analysis; other modeled outputs, e.g., changes in the predicted frequency and pervasiveness of exceedances and predicted changes in the design value; actual observed air quality trends; estimated emissions trends; analyses of air quality monitored data; the responsiveness of the model predictions to further controls; and, whether there are additional control measures that are or will be approved into the SIP but were not included in the modeling analysis. This list is not an exclusive list of factors that may be considered and these factors could vary from case to case. The EPA's guidance contains no limit on how close a modeled attainment test must be to passing to conclude that other evidence besides an attainment test is sufficiently compelling to suggest attainment. However, the further a modeled attainment test is from being passed, the more compelling the WOE needs to be.

Because of the complexities of modeling the influence of long-range transport of ozone and ozone precursor emissions, many areas, particularly those in the Northeast part of the country, were unable to produce attainment demonstrations by the November 1994 CAA deadline. To address this problem, on March 2, 1995 Assistant Administrator for Air and Radiation, Mary D. Nichols, issued a policy memorandum, entitled "Ozone Attainment Demonstrations", to provide guidance to the states on an alternative approach for meeting the attainment demonstration and rate-of-progress requirements of the CAA. The policy memorandum established a two-phased approach for the submittal of the attainment demonstration. Under the first phase, states were to submit a plan with specific control measures, including a plan to show at least a 9 percent rate of progress reduction by 1999; interim assumptions or modeling about ozone transport; and enforceable commitments to: 1) participate in a consultative process to address regional transport, 2) adopt additional control measures as necessary to attain the ozone NAAQS, and 3) identify any reductions that are needed from upwind areas for the area to meet the ozone standard. The second phase of this approach began with a two year process to assess regional control strategies and refine local control strategies that included improvements to the modeling process. The goal of Phase II was for EPA and the affected Northeastern states, including Pennsylvania, to reach consensus on the additional regional, local and national emissions reductions that are needed for attainment. The phased approach policy gave states until mid-1997 to submit their modeling and attainment demonstrations, commonly referred to as the Phase

II attainment plan. The attainment demonstration should identify the measures that are needed for both rate-of-progress through the attainment year and attainment of the ozone NAAQS. The requirements for Pennsylvania to demonstrate rate-of-progress through the attainment year will be addressed by EPA through separate rulemaking action. The rulemaking that will accompany this Technical Support Document will only address the adequacy of Pennsylvania's attainment demonstration and photochemical modeling for the Philadelphia area.

The process to study long-range ozone transport that resulted from the March 1995 phased approach policy led to the formation of the Ozone Transport Assessment Group (OTAG). Thirty-seven states plus the District of Columbia, industry representatives, environmental groups, academic organizations and EPA participated in the two year OTAG study. EPA advised states that their attainment plans would be due after OTAG completed its study and made its recommendations. In July 1997, OTAG made numerous recommendations to EPA for controlling long-range ozone transport, one of which included, reducing emissions of nitrogen oxide (NOx) precursor emissions from large stationary sources throughout the entire OTAG domain. Following the OTAG recommendations, EPA issued the "NOx SIP Call" in September 1998 to require 22 states, plus the District of Columbia, to reduce NOx emissions which contribute to regional transport of ozone. EPA completed final rulemaking on the NOx SIP Call on October 27, 1998. To address transport, the NOx SIP Call established emissions budgets for NOx that 22 jurisdictions were required to meet through enforceable SIP measures adopted and submitted by September 30, 1999. The NOx SIP Call is intended to reduce emissions in upwind states that significantly contribute to nonattainment problems. The EPA did not identify specific sources that the States must regulate nor did EPA limit the States' choices regarding where to achieve the emission reductions. Subsequently, a three-judge panel of the Court of Appeals for the District of Columbia Circuit issued an order staying the SIP submission requirement portion of the NOx SIP Call rule.

IIB. Framework for Proposing Action on the Pennsylvania Attainment Demonstration SIP

In addition to the modeling analysis and WOE demonstration to support attainment, EPA has identified the following key elements which must be present in order for EPA to approve or conditionally approve the 1-hour attainment demonstration SIPs. These elements are listed below and then described in detail.

- **CAA measures and measures relied on in the modeled attainment demonstration SIP.** This includes adopted and submitted rules for all previously required CAA mandated measures for the specific area classification. This also includes measures that may not be required for the area classification but that the State relied on in the SIP submission for attainment and ROP plans on which EPA is proposing to take action on today.
- **NOx reductions affecting boundary conditions.**
- **Motor vehicle emissions budget.** A motor vehicle emissions budget which can be determined

by EPA to be adequate for conformity purposes.
- **Tier 2/Sulfur program benefits where needed to demonstrate attainment.** Inclusion of reductions expected from EPA's Tier 2 tailpipe and low sulfur-in-fuel standards in the attainment demonstration and the motor vehicle emissions budget.
- **In certain areas, additional measures to further reduce emissions to support the attainment test.** Additional measures, may be measures adopted regionally such as in the Ozone Transport Region (OTR), or locally (intrastate) in individual States.
- **Mid-course review.** An enforceable commitment to conduct a mid-course review and evaluation based on air quality and emission trends. The mid-course review would show whether the adopted control measures are sufficient to reach attainment by the area's attainment date, or that additional control measures are necessary.

An analysis of Pennsylvania's SIP submittal and how it satisfies the framework for this proposed action is discussed in section V. of this TSD. For a detailed discussion of this framework, see the Notice of Proposed Rulemaking(NPR) for this action

IIC. Pennsylvania's Attainment Demonstration Submittal

On April 30, 1998, Pennsylvania submitted the Post-99 rate-of-progress (ROP) plan and attainment demonstration for the Philadelphia severe ozone nonattainment area. On August 21, 1998, Pennsylvania supplemented its attainment demonstration with EPA's regional scale modeling, developed in support of EPA's September 24, 1998 NOx SIP Call. Pennsylvania's attainment SIP for the Philadelphia-Wilmington-Trenton severe ozone nonattainment area relies on a combination of local, regional and federal measures adopted by the State and federal government since passage of the 1990 amendments to the Clean Air Act. Because Pennsylvania has incorporated the regional scale modeling developed by EPA in support of the regional NOx SIP Call, promulgated on September 24, 1998, the Pennsylvania attainment plan assumes reductions from the NOx SIP Call.

III. Local Modeling

III.A. Description of Models

The Clean Air Act Amendments of 1990 require that serious areas and above perform photochemical grid modeling to help determine the emission reductions of volatile organic compounds (VOC) and nitrogen oxides (NOx) necessary to achieve the attainment of the 1-hour ozone standard. The Pennsylvania Department of Environmental Protection (PADEP) fulfilled this requirement through the application of the Urban Airshed Model, Version 4 (UAM-IV) and through the use of the modeling results from the OTAG application of the Urban Airshed Model, Version 5 (UAM-V).

The UAM-IV, UAM-V models are suitable for evaluating the air quality effects of emission control scenarios because they account for the spacial and temporal variations in emissions and emission reactivity. This is achieved by using the model to replicate an historical ozone episode through the use of observed meteorological data, emissions data and air quality data for the selected episode days. The results of this base case analysis are then evaluated to determine the adequacy of the performance of the model. Once the model results have been evaluated and determined to perform within prescribed levels, the same base year meteorological inputs for each episode are combined with attainment year projected emission inventories to simulate the benefits of various emission control scenarios in bringing an area into attainment.

The UAM-IV model, used in the modeling demonstration for the Philadelphia area, is the regulatory version approved by the EPA. UAM-IV incorporates the Carbon-Bond IV (CB-IV) chemical mechanism. The UAM-V model used by OTAG is an updated version (Version 1.24). It incorporates the CB-IV chemical mechanism with updated isoprene and radical-radical reactions. Features of the UAM-V modeling system include variable vertical grid structure, two-way nested grid, plume-in grid treatment, etc. A detailed description of the UAM-V modeling system is provided in the user's guide.

III.B. Episodes

PADEP focused on two episodes (July 7-8, 1988 and July 19-20, 1991) in their attainment year modeling demonstration. These episodes correspond to episodes selected for analysis by the Ozone Transport Assessment Group (OTAG) and represent one of the most frequently occurring weather patterns conducive to high ozone in the Philadelphia area. A description of the modeled episodes follow.

July 7-8, 1988

- Surface ozone concentrations indicated a large area of high ozone concentrations across the Midwest, Northeast and Southeast regions.

- Synoptic weather conditions showed a large area of high pressure building over the northern Great Lakes gradually moving east so that much of eastern United States was covered by high pressure for six to seven days. Temperatures exceeded 90 degrees Fahrenheit for several days in the Midwest, Northeast and Southeast regions. These conditions allowed pollutant concentrations to build up to high levels.

- Progression of high ozone concentrations and synoptic weather conditions suggested interstate and interregional transport.

July 19-20, 1991

- Surface ozone concentrations indicated a large area of high ozone concentrations across the Midwest and Northeast regions

- Synoptic weather conditions showed a large area of high pressure building over the central plains and moving gradually east so that much of eastern United states was covered by high pressure for several days. Temperatures exceeded 90°F for several days in the Midwest and Northeast regions. These conditions allowed pollutant concentrations to build up to high levels.

- Progression of high ozone concentrations and synoptic weather conditions suggested interstate and interregional transport.

III.C. Model Setup

The origin of the initial grid in the modeling domain is 350 kilometers (km) east and 4,285 km north, in UTM zone 18. The domain's northward extent is 295 km north and its eastward extent is 260 km east of the origin. The portion of the modeling domain used for regulatory purposes excludes five rows of cells at the domain's northern boundary and four columns of cells at the domains eastern boundary. Each grid cell in the domain is a 5 km x 5 km square. The domain includes all nonattainment counties as well as many surrounding attainment counties and includes portions of Pennsylvania, Delaware, Maryland and New Jersey.

UAM-IV was run using five vertical layers with three layers above the morning mixing height (diffusion break in UAM). Additionally, the top of the modeling domain (region top in UAM) was specified above the mixing height by at least the depth of one upper layer cell. This was accomplished by setting the region top value equal to the maximum mixing depth plus the minimum depth of the upper layer cells.

Initial and boundary conditions were derived from EPA's Regional Oxidant Model (ROM) and OTAG modeling results for episodes corresponding to the local episodes chosen. Ozone Transport Commission (OTC) control strategy E and OTAG Run 2 were used to develop attainment year boundary conditions for the July 1988 and the July 1991 respectively. OTAG Run 5 boundary conditions, which are most representative of the boundary conditions that will result from the proposed budgets in the NOx SIP Call final rule, were not used in the local modeling because they were not available when the Rutgers University Ozone Research Center performed the future year modeling for PADEP. OTC Run E emission controls are representative of the emission controls applied in OTAG Run 5. Although OTAG Run 2 contains emission controls that are more restrictive than OTAG Run 5, a comparison was made between ozone concentrations predicted by Run 2 and Run 5 . Attachment 4 contains plots containing peak ozone concentrations for July 20, 1991 for Run 2 and Run 5. July 20, 1991 is the primary episode day for the July 19-20, 1991 episode. The peak concentration plots from Run 2 and Run 5 are very similar, which suggests that the boundary conditions produced by each of these runs are similar. OTC Run E was used to develop boundary conditions for the July 7-8, 1988 episode. The July 19-20, 1991 episode was modeled with both OTC Run E boundary conditions and OTAG Run 2 boundary conditions. The meteorological fields were developed through application of the Diagnostic Wind Model (DWM) developed by System Application International (SAI) as part of the UAM-IV modeling system.

III.D. Base Year Emissions

Base year emissions were provided by the individual states covered by the modeling domain. In cases where a state did not have the appropriate inventory information, PADEP relied heavily on the emissions inventories developed in the OTAG process. However, when the July 1988 episode was modeled, the OTAG inventories and state inventories were not available, so modeling was performed using EPA's interim emissions inventory. PADEP performed extensive quality assurance checks on the emissions data to ensure consistency and accuracy of these data from one state to another. EPS 2.0 and EMS-95 were used to grid and speciate state provided emission inventories.

III.E. Model Performance

In general, the UAM-IV modeling does an adequate job representing the distribution of ozone concentrations in the area. However, for the July 1991 episode the model over-predicts concentrations, particularly in the central New Jersey area. The area just upwind of the central New Jersey area had a measured concentration of 151 ppb while the model predicted concentrations are in the range of 156 - 190 ppb. This indicates the model may be over-predicting by an average of 15 %. The degree to which the peak predicted values exceed the measured values in the same general vicinity, indicates that the model is systematically over-predicting while adequately representing the spacial distribution of ozone. The base case model performance for the July 1991 episode shows good alignment of the modeled ozone plume in comparison to monitored ozone values. Model predicted peak concentrations and monitored peak concentrations are generally paired in space. This suggests that the peak concentration over-prediction is most likely real and not due to model-predicted peaks in an unmonitored area that may be actually experiencing high ozone concentrations. Model performance statistics are within the ranges deemed acceptable by EPA (see Table 1. In Appendix C5, **State Implementation Plan (SIP) Revision for the Philadelphia Interstate Ozone Nonattainment Area Phase, April 1998**). The same general comments can be made about model performance for the July 1988 episode accept that the model does not seem to be over-predicting ozone concentrations.

III.F. Attainment Year Modeled Emissions and Control Measures

Attainment year emission inventories were developed through the use of Bureau Economic Analysis (BEA) growth factors for area source (VOC & NOx) and point source (VOC) growth. EGAS growth factors were used for off-road mobile source (VOC & NOx) and point source (NOx) emission projections. EPS-2 and EMS-95 along with Mobile 5b were used to grid and speciate emissions for the July 1988 and the July 1991 episodes respectively. Column three of Table III.F-1 represents the percentage reduction in emissions from the 1990 levels expected in the Pennsylvania portion of the Philadelphia interstate nonattainment area. The percentage reduction takes into account growth as well as emission reductions from measures adopted since 1990. Column four represents the percentage reduction of NOx emissions from 1990 to 2005 when emission reductions anticipated from the NOx SIP Call are combined with reductions from all other local measures.

Table III.F-1 - Pennsylvania Portion of the Philadelphia Area Emissions (tons/day)

	1990	2005	% Reduction
NOx	487	317	35
VOC	669	428	36

Tables III.F-2 provides the status of each control measure identified by the PADEP Phase II Plan. All state measures relied on in the demonstration of attainment, with the exception of the NOx SIP Call, have been adopted and implemented by the Commonwealth of Pennsylvania. However, EPA has not fully approved the following measures:

- RACT (generic RACT conditional limited approval)
- OTC NOx MOU Phase 2 (proposed approval)

The table shows the state adoption date of the measure, the implementation and/or compliance date of the measure and the approval status of the measure. EPA has previously analyzed Pennsylvania's control measure strategies for effectiveness, enforceability and approvability. More information on the appropriateness of Pennsylvania's strategies can be found in the individual rulemaking dockets associated with EPA's SIP approvals of the underlying regulations and other SIP planning documents such as the rate-of-progress plans for the Philadelphia nonattainment area.

Later in this TSD, there is a table identifying all CAA mandated measures implemented by Pennsylvania to date, and the approval status of each.

Table III.F-2 Control Measures in the 1-Hour Ozone Attainment Plan for the PA Portion of the Philadelphia Area

Control Measure	Measure Type	Adopted	Implementation (start-up) Date	SIP Approval
Highway and Non-road Mobile Source Controls				
FMVCP/Tier I vehicle standards	federal	yes	MY[1] 94	federal rule
Enhanced Inspection & Maintenance (I/M)	state	yes	October 97	SIP approved 6/17/99
Reformulated Gasoline	federal	yes	January 95	federal rule
Stage II	state	yes	February 92	SIP approved 12/13/95
On Board Vapor Recovery	federal	yes	MY 98	federal rule
Compressed Ignition Non-road Diesel Engines	federal	yes	MY 96	federal rule
Small Non-road (Spark Ignition) Engines	federal	yes	MY 96	federal rule
National Low Emission Vehicles (NLEV)[2]	state	yes	MY 99	submitted 1/8/99, approval pending
Stationary Source Controls				
Reasonably Available Control Technology (RACT)	state	yes	May 95	generic rule - conditional limited approval 2/23/98 (effective 4/22/98)
OTC NOx MOU Phase 2	state	yes	May 99	proposed approval 1/26/99 (64 FR 3906)

[1] Implementation starting with the vehicle model year (MY)

[2] While Pennsylvania did not include NLEV as part of its rate-of-progress plan, the Commonwealth did include NLEV in its local modeling, in Control Strategy Two.

Control Measure	Measure Type	Adopted	Implementation (start-up) Date	SIP Approval
Enhanced Rule Compliance[3]	**state**	**yes**	**September 97**	**submitted 7/31/98 (part of PA's Phase I plan), proposed approval 8/25/99 (64 FR 46325)**
Shutdowns[4]	**state**	**yes**	**N/A (after 1990)**	**N/A**
Waste Treatment, Storage and Disposal Facilities (TSDFs)	**federal**	**yes**	**December 97**	**federal rule**
NOx SIP Call[5]	**state**	**no**	**no**	**Stayed by Federal Court**
Area Source Controls				
Architectural & Industrial Maintenance Coatings	**federal**	**yes**	**September 99**	**federal rule**
Autobody Refinishing	**federal**	**yes**	**January 99**	**federal rule**
Consumer & Commercial Products	**federal**	**yes**	**December 98**	**federal rule**

[3] EPA has reviewed PADEP RE protocol and determined that Pennsylvania included Rule Effectiveness (RE) as a contingency measure in the rate-of-progress plan and as a control measure in the attainment demonstration. RE is a means of enhancing rule compliance or implementation by industrial sources. RE is stated as a percentage of total available reductions from a control measure. The default assumption level for rule effectiveness is 80%. Pennsylvania claims RE improvements from the 80% default level to a level of 90%. As with Pennsylvania's other control measures, EPA has previously reviewed PADEP protocol for achieving RE to a level of 90% and determined the protocol to meet EPA's RE improvements matrix. However, Pennsylvania's RE state initiative will not specifically be discussed with this action of approval of the attainment demonstration. The RE measure will be discussed in detail with the post 1999 ROP action.

[4] All shutdowns occurred after 1990. This measure is not a regulation. There is no "implementation date," and SIP approval is not required.

[5] Credit from this measure was assumed in the regional modeling, Pennsylvania must submit measures modeled in the attainment demonstration by 12/31/00. See section entitled Framework for approval included in this TSD.

III.G. Attainment Year Modeling

Due to time constraints and resource limitations, attainment year modeling was performed for two episodes, July 7-8, 1988 and July 19-20, 1991. EPA modeling guidance requires that at least three episodes should be modeled from at least two different meteorological regimes conducive to high ozone. Both of these episodes represent very severe ozone events with meteorological ozone forming potential rankings of less than 80 out of all days over the last fifty years (Cox and Chu 1996). Cox and Chu analysis ranked all summer days over the past 50 years according to their meteorological ozone forming potential. The most severe day over the past 50 years would receive a rank of one. Given the severity of these episodes, they are likely to be the controlling episodes in the Philadelphia area in the determination of emission reductions needed for attainment. These episodes also represent the meteorological regime most frequently responsible for elevated ozone concentrations in the Philadelphia area (see section II.B. Episodes). Although the required three episodes were not modeled for the attainment year, PADEP believes the requirements outlined in the Dick Wilson memorandum, **Guidance for Implementing the 1-Hour Ozone and Pre-Existing PM-10 NAAQS, December 1997** have been fulfilled.

The attainment year modeling was performed with UAM-IV and adhered to the requirements outlined in the document entitled, **Guideline for the Regulatory Application of the Urban Airshed Model, EPA-450/4-91-013.** This modeling included 2005 controlled emissions reflective of the emission reductions presented in Section III.F. of this TSD. ROM OTC E and OTAG Run 2 boundary conditions were used in the modeling along with wind fields that were developed through application of the Diagnostic Wind Model (DWM).

For the July 1988 and July 1991 episodes, modeled peak ozone concentrations are reduce by an average of approximately 31 ppb once controls in the Phase II plan are applied. When this reduction is applied to the peak measured concentration for the July 1991 episode (155 ppb), the resulting concentration is 124 ppb which indicates attainment. This would not be true for the July 1988 episode, where the peak monitored concentration was 210 ppb. However, EPA believes that the modeling results from July 1988 episode should be given less weight in the overall determination of attainment in the Philadelphia area for the following reasons. 1.) The July 7-8, 1988 episode was an extreme event that is atypical of the area. Peak monitored ozone concentrations of 210 ppb on both July 7 and 8 and a Cox-Chu ranking (ranks episode days according to their meteorological ozone forming potential) of 11 on July 8 are indicative of the extreme severity of this episode. For this episode the Cox-Chu rankings for New York City (NYC) were used to determine episode severity. It is appropriate to use the episode rankings for NYC rather than Philadelphia since the peak modeled ozone concentrations, that are driving ozone nonattainment in the Philadelphia area for the July 1988 episode, are in the northeastern portion of the domain near NYC. This leads to the second reason this episode should carry less weight. 2.) Peak modeled concentrations of ozone that are driving ozone nonattainment for this episode occur in the NYC portion of the modeling domain. It is doubtful that the application of any control strategy in the Philadelphia area would result in modeled attainment in the NYC portion of the domain. 3.) Finally, it should also be noted here that the 2005 emission projections used in the 1988 episode are based on EPA's interim emissions inventory. This inventory contains significant errors and may not be of sufficient quality to produce an adequate attainment demonstration.

When the control strategy is applied, both episodes show an 81-85 % reduction in the number of cells with modeled concentrations above 124 ppb. This is in excess of the 80% reduction requirement of the third benchmark of the Statistical Attainment Test described in the EPA document entitled, **Guidance on the Use of Modeled Results to Demonstrate Attainment of the Ozone NAAQS, EPA-454/B-95-007.**

The procedures for the Statistical Test, outlined in the document cited above, allows peak modeled ozone concentrations in excess of 124 ppb for episode days when the ozone forming potential rank is very high. Modeling shows that peak ozone concentrations for the July 19-20, 1991 episode are clustered in the northeast portion of the modeling domain near NYC. Again, for this reason it is appropriate to use the Cox-Chu rankings for NYC. The ranking for July 19, 1991 is 23. In this case a peak modeled concentration of 130 ppb would be considered attainment. The modeled peak concentration on this day is 138 ppb. July 20, 1991 is ranked 7 with a peak modeled and target concentration of 149 ppb and 141 ppb respectively.
Following the screening test defined in the proposed Guidance 8-hour ozone modeling guidance entitled **Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS, May 1999**, the information in the table below is used to calculate the "relative reduction factor" (RRF) and project a domain wide "future design value". The episodes modeled were July 7-8, 1988 & July 19-20, 1991 and the 1989-1991 observed air quality design value is 152 ppb.

Domain maxima concentrations with predicted peak allowed based on 44 year rankings (ppb) along with percent change in predicted peak for all days modeled				
Day	Observed	Base Case Predicted	Control 2007 Predicted	Peak Allowed (Ranking)
July 7, 1988	210	185	159	124(214)
July 8, 1988	210	190	151	130(11)
July 19, 1991	150	156	138	130(23)
July 20, 1991	151	190	149	141(7)
	Totals:	721	597	

	Averages:	180.3	149.3	

RRF=Avg. Future/Avg. Current = 150/186 = .83

Future design value = (Current design value for 89-91) ∗ RRF = 152ppb ∗ .83 = **126 ppb**

The outcome of the screening test, which is based on the local-scale modeling, is an area-wide design value that has been reduced to126 ppb. This is only 2 ppb above the attainment design value (124 ppb). This result, along with local scale modeling for the 1991 episode that shows peak concentrations within 8 ppb of the target concentrations, warrant the consideration of the next section's weight-of evidence arguments that provide additional evidence that attainment of the ozone standard is likely.

IV. Weight of Evidence

A weight of evidence determination is a diverse set of technical analyses performed to assess the confidence one has in the modeled results and to help assess the adequacy of a proposed strategy when the outcome of local-scale modeling is close to attainment.

IV.A. Using Ambient Data and NOx SIP Call Modeling to Evaluate Attainment

In July 1998, EPA recommended the use of a methodology that uses the results from modeling performed to support EPA's NOx SIP Call Supplemental Notice of Proposed Rulemaking (SNPR)[6]. This methodology uses the SNPR modeling results in a manner that better replicates the monitored attainment test. The monitored attainment test requires that the design value recorded at each monitor in the nonattainment area be less than 125 ppb. The design value is the fourth highest 1-hour average measured ozone concentration over a period of three years.

The SNPR modeling was used by EPA to estimate the amount of ozone reductions achieved after regional NOx controls are in place. The ozone reduction estimate was determined by examining modeled ozone concentrations from three episodes (1991, 1993 and 1995) in the 1995-1996 base year period and the 2007 control case and then constructing county-specific reduction factors. A complete description of this procedure is included in Attachment 1. Reduction factors were then applied to county-specific design values for the 1996 time period. The resulting ozone concentrations were then compared to the current 1-hour ozone standard used for monitoring and modeling purposes (124 ppb) to determine the likelihood of a particular county reaching

[6] Federal Register/Vol. 63, No. 90/Monday May 11, 1998/Proposed Rules
Web Document: http://www.access.gpo.gov/su_docs/aces/aces140.html ,
Search federal register "SNPR"

attainment after the NOx SIP Call controls are in place. Results from this exercise are described in a memorandum from Bill Hunt (Attachment 2). A summary document of containing the adjusted design values resulting from EPA's analysis for all of the counties with ozone monitors in the 22 state area affected by the NOx SIP Call can be found in Attachment 3.

The results of EPA's rollback analysis show attainment for all of the counties in the Philadelphia-Wilmington Trenton interstate ozone nonattainment area. To provide additional information that continues to support attainment for the Philadelphia the adjustment factors developed in EPA's analysis were also applied to the 1997 and 1998 Philadelphia area design values. The results presented in Table IV.A-1 show all area design values below 124 ppb.

Table IV.A-1 Adjusted Design Values for the Philadelphia Area Based on the NOx SIP Call SNPR Modeling

County/State	1996 Design Value (ppb)	Adjusted 1996 Design Value (ppb)	1997 Design Value (ppb)	Adjusted 1997 Design Value (ppb)	1998 Design Value (ppb)	Adjusted 1998 Design Value (ppb)
Philadelphia/PA	130	116	130	116	125	112
Delaware/PA	124	106	126	108	126	108
Bucks/PA	137	117	137	117	119	102
Montgomery/PA	118	98	122	101	126	104
Cecil/MD	139	115	152	123	152	123
Kent/MD	115	95	124	102	128	106
New Castle/MD	134	110	139	114	127	104
Camden/NJ	127	109	137	117	129	111
Cumberland/NJ	105	86	115	94	115	94
Gloucester/NJ	125	108	128	111	122	103
Mercer/NJ	134	113	131	110	121	102

The information in Table IV.A-1 shows that regional emission reductions required in the NOx SIP Call, when paired with Pennsylvania's current control strategy as well as the control strategies in other states within the Philadelphia ozone nonattainment area, will most likely result in the attainment of the 1-hour ozone standard.

IV.B. Identification of Additional Emission Reductions Needed for Attainment

To strengthen the weight of evidence and account for high locally modeled peak concentrations, EPA developed a methodology that uses the local scale photochemical grid modeling results along with ambient air quality monitoring data to determine levels of emission reductions beyond the reductions contained in the 1998 Phase II Plans needed to support attainment of the 1-hour NAAQS for ozone. The EPA methodology is described in the guidance document entitled **Guidance for Improving Weight of Evidence Through Identification of Additional Emission Reductions, Not Modeled** located in Attachment 5. Attachment 5 also contains the data sheet containing the specific information that went into the analysis for the Philadelphia area. EPA Method 2 (see Attachment 5) was deemed most appropriate for the determination of additional emission reductions in the Philadelphia area because it integrates the use of both modeled and monitored data. Table IV.B-1 contains the results of the analysis for the Philadelphia area. The EPA analysis shows that the Philadelphia area needs an additional NOx emission reduction of 3 tons per day and an additional VOC emission reduction of 62 tons per day for the area to demonstrate attainment of the ozone NAAQS. Because EPA's analysis includes the emission reductions expected from the Tier 2 rule, Tier 2 reductions may not be used to cover the additional emission reduction requirement. The additional VOC emission reductions may be achieved through NOx substitution in accordance with existing EPA guidance. The Pennsylvania attainment plan for Philadelphia contains an enforceable commitment to adopt whatever rules are necessary to attain the 1-hour NAAQS for ozone.

Table IV.B-1 Additional Emission Reductions Needed for Attainment

Nonattainment Area and Attainment Date	Method 2--Monitored Air Quality and the National Emissions Trends (NET) Inventory	
	NOx	VOC
Philadelphia (2005)	3.4 T/day	62 T/day
NOTES: 1. Emission reductions include 2005 Tier 2 reductions for Baltimore.		

IV.D. Adjustment of Modeled Peak Concentrations for Model Over-prediction

As discussed in the model performance section of this TSD (**Section III.C.**) UAM-IV over-predicts peak ozone concentrations for the July 19-20, 1991 episode by approximately 15 %.

When modeled peak concentrations are reduced by 15 %, the result is an adjusted peak concentration of 117 ppb for July 19th and 127 ppb for July 20th. The adjusted peak concentration for the 19th indicates attainment as does the adjusted peak concentration for the 20th which, due to the severity of this particular episode day, could be as high as141 ppb and still be considered attainment.

V. Analysis of State Submittal Against the Framework for Proposing Action

1. CAA measures and measures relied on in the current SIP submission

The following table. contains the CAA required control measures the Commonwealth has implemented and the federal approval status of each.

Commonwealth of Pennsylvania Control Measures in the 1-Hour Ozone Attainment Plans for the Philadelphia Area			
Name of Control Measure or SIP Element	Type of Measure	Included in Local Modeling	Approval Status
Enhanced Inspection & Maintenance	CAA SIP Requirement	Yes	SIP approved- 6/17/99 [64 FR 32411]
NOx RACT	CAA SIP Requirement	Yes	SIP approval pending- Final Conditional approval 3/23/98 [63 FR 13789]
VOC RACT	CAA SIP Requirement	Yes	SIP approval pending- Final Conditional approval 3/23/98 [63 FR 13789]
Stage II Vapor Recovery	CAA SIP Requirement	Yes	SIP approved- 12/13/95 [60 FR 63940]
On-board Refueling Vapor Recovery	federal rule	Yes	Promulgated at 40 CFR 86
Stage I Vapor Recovery	CAA SIP Requirement	Yes	SIP approved
Federal Motor Vehicle Control program	federal rule	Yes	Promulgated at 40 CFR 86

Commonwealth of Pennsylvania Control Measures in the 1-Hour Ozone Attainment Plans for the Philadelphia Area			
Name of Control Measure or SIP Element	Type of Measure	Included in Local Modeling	Approval Status
Federal Non-road Gasoline Engines	federal rule	Yes	Promulgated at 40 CFR 90
Federal Non-road Heavy Duty diesel engines	federal rule	Yes	Promulgated at 40 CFR 89
AIM Surface Coatings	federal rule	Yes	Promulgated at 40 CFR 59 subpart D
Consumer & commercial products	federal rule	Yes	Promulgated at 40 CFR 59 subpart C
Autobody refinishing	federal rule	Yes	Promulgated at 40 CFR 59 subpart B
Reformulated Gasoline	federal rule	Yes	Promulgated at 40 CFR 80 subpart D
National Low Emission Vehicle (NLEV)	State opt-in	Yes	Federal program promulgated at 40 CFR 86 subpart R. State opt-in adopted and submitted; SIP approval pending.
OTC NOx MOU Phase II	State initiative	Yes	SIP approval pending.
Clean Fuel Fleets	CAA SIP Requirement	No	NLEV Substitute Adopted and submitted; SIP approval pending
Marine Engine Standards	federal rule	No	Promulgated at 40 CFR 91
Railroad Engine Standards	federal rule	No	Promulgated at 40 CFR 92
Heavy Duty Diesel Engines (On-road)	federal rule	No	Promulgated at 40 CFR 86

Commonwealth of Pennsylvania Control Measures in the 1-Hour Ozone Attainment Plans for the Philadelphia Area			
Name of Control Measure or SIP Element	Type of Measure	Included in Local Modeling	Approval Status
New Source Review	CAA SIP Requirement	N/A[1]	SIP approval pending- Limited approval/no disapproval 12/9/97 [62 FR 64722]
15% VOC Reduction Plan	CAA SIP Requirement	Yes[2]	SIP approval pending- Final interim conditional approval 6/9/97 [62 FR 31343]
Base Year Emissions Inventory	CAA SIP Requirement	N/A	SIP approved.-1990 VOC by EI 6/9/97 [62 FR 31343] 1990 NOx by EI 6/17/99 [62 FR 32422]
Emissions Statements	CAA SIP Requirement	N/A	SIP approved.-1/12/95 [60 FR 2881]
9% rate of progress plans	CAA SIP Requirement	Yes[2]	SIP approval pending
Improving rule effectiveness from 80% to 90%	State Initiative	Yes	SIP approval pending
Fees for Major Sources for failure to attain	CAA SIP Requirement	No[3]	SIP due 12/31/2000

[1] Does not produce emission reductions.
[2] The measures used to demonstrate rate of progress were modeled.
[3] This measure will only take effect if the area fails to attain by 2005 and would only be implemented after 2005.

The PADEP has submitted all CAA mandated measures, though many but not all of these measures have been approved to date. EPA is proposing approval of the attainment demonstration for the Philadelphia area contingent upon issuance of a SIP approval of all CAA required measures and other attainment measures before final approval is issued for the attainment demonstration.

2. NOx reductions affecting boundary conditions

The Commonwealth of Pennsylvania relied upon the NOx SIP Call reductions in the Philadelphia area attainment demonstration plan. Therefore, a crucial element of the attainment demonstration for the Philadelphia area is the adoption and implementation of NOx controls consistent with the modeling demonstration. As discussed in with the framework for approval, Pennsylvania must adopt NOx SIP Call level controls within the modeling domain in order to have an approvable attainment demonstration. Pennsylvania must submit to EPA adopted control measures consistent with the NOx reductions assumed in the attainment demonstration before EPA may approve the attainment demonstration SIP.

3. Motor vehicle emissions budget

This information is contained in a separate TSD, but is included as part of this rulmaking action.

4. Tier 2/Sulfur program benefits

As a result of EPA's review of the State's SIP submittal, EPA believes that the ozone modeling submitted by the Commonwealth of Pennsylvania for the Philadelphia area upon which EPA is proposing to approve and to disapprove-in-the-alternative will need the emission reductions from EPA's Tier 2/Sulfur program to attain the 1-hour ozone NAAQS. Further, EPA believes that the Philadelphia area will need additional emission reductions identified by EPA, beyond those from EPA's Tier 2/Sulfur program, to attain the 1-hour ozone NAAQS.

For the Philadelphia area, EPA is proposing to determine that the submitted control strategy does not provide for attainment by the attainment deadline. However, the emission reductions of EPA's Tier 2/Sulfur program, which are not reflected in the submitted SIP, will assist in attainment. Because the Philadelphia area must rely on reductions from the Tier 2/Sulfur program in order to demonstrate attainment, the effects of these standards must be included in the motor vehicle emissions budget.

To assist the States whose counties comprise the Philadelphia area in the preparation of a new submission which could be approved or conditionally approved, EPA has prepared an estimate of the air quality benefits of EPA's Tier 2/Sulfur program. In our calculation, EPA assumed that all of the Tier 2/Sulfur emissions reductions will contribute to the ability of the Philadelphia area to demonstrate attainment. The EPA has further calculated how much additional emission reduction is needed for the Philadelphia area in order for EPA to approve or conditionally approve a revised and re-submitted attainment demonstration for this area. The EPA suggests that the States include these calculations as part of the WOE analysis accompanying the adjusted attainment demonstration and revised motor vehicle emissions budget for this area. Today, EPA is proposing to approve a new attainment demonstration if it meets this description.

However, States can use some of EPA's Tier 2/Sulfur program credit for other purposes. Thus, the States could take credit for all or some of EPA's Tier 2/Sulfur program credit for their attainment demonstration.

If the Tier 2/Sulfur program credit the States are assuming for attainment is less than the amount that EPA assumed in calculating the amount of additional emission reductions needed to attain, i.e., the States are applying some or all of the Tier 2/Sulfur program credit for other purposes, the States will have to calculate the new additional emission reductions needed and commit to adopt measures to achieve them. If the States assume all the Tier 2/Sulfur program credit will go toward attainment, then the States will be able to rely on EPA's estimate of the additional emission reductions needed.

Revisions to the Motor Vehicle Emissions Budget and the Attainment Demonstration When EPA Issues the MOBILE6 Model

Pennsylvania has previously committed to adopting additional control measures as necessary to attain the one-hour ozone NAAQS. EPA believes for the purposes of determining the motor vehicle emissions budget adequate that Pennsylvania already has a commitment to adopt any needed additional measures, but we need reaffirmation from PADEP that the intent of the existing commitment meets all the conditions as stated with the framework of this action including revising the mobile vehicle emissions budget when EPA issues the MOBILE6 model. EPA needs to receive this reaffirmation by December 31, 1999. If Pennsylvania does not reaffirm by December 31, 1999, that its existing commitment to adopt additional measures as necessary to reach attainment is consistent within the framework of this action, then EPA will be unable to determine the area has an adequate conformity budget. The commitment to revise the SIP after MOBILE6 may be submitted at the same time that the state submits the budget that includes the effects of Tier 2 (no later than July 1, 2000).

5. Additional measures to further reduce emissions to support the attainment test

Based on the results of the local scale modeling along with the additional weight-of-evidence analyses provided in the attainment demonstration for the Philadelphia area, EPA believes that PADEP has successfully demonstrated attainment of the 1-hour ozone standard for the Philadelphia area by the 2005 statutory date if PADEP provides a reaffirmation by letter that its previously submitted enforceable commitment to adopt additional measures to further reduce emissions includes those necessary to support the attainment test as previously stated in this TSD. EPA has determined that the Philadelphia area will need additional emission reductions of 0.3 percent per day of NOx and 4.5 percent per day of VOC to ensure attainment of the ozone NAAQS. The baseline for these percentages is the 1990 emissions inventory. These reductions are in addition to the NOx and VOC emission reductions that will be achieved from the Tier 2 rule.

6. Mid-course review

In accordance with the provisions of the framework for approval for Pennsylvania's attainment demonstration, EPA must receive an enforceable commitment or a reaffirmation of a previous enforceable commitment to include a mid-course review from PADEP for the Philadelphia area.

VI. Summary

The ozone attainment demonstration contained in the Pennsylvania submittal entitled, **State Implementation Plan (SIP) Revision for the Philadelphia Interstate Ozone Nonattainment Area Meeting the Requirements of the Alternative Ozone Attainment Policy Phase II,**

April 1998 contains local scale modeling that, other than the number of episodes modeled, fulfills EPA recommended modeling procedures. Given the severe nature of the episodes modeled, even if three episodes were modeled, the two episodes that were modeled (July 7-8, 1988 & July 18-20, 1991) would probably be the controlling episodes in the determination of the emission reductions needed in the Philadelphia area for attainment. When the 2005 emission inventory with the control strategy is modeled, peak ozone concentration is reduced by approximately 31 ppb from the modeled peak concentrations in the 1988 and 1991 base cases. When this reduction is applied to the peak measured concentration for the July 1991 episode (155 ppb), the resulting concentration is 124 ppb which indicates attainment. When model over prediction is accounted for in the July 1991 episode, the local-scale modeling predicts a peak concentration of 127 ppb. In this case, EPA's alternative attainment test guidance will allow a peak concentration of 141 ppb due to the severity of the meteorological forming potential of the episode day and still consider the modeled result attainment. The attainment emission control strategy contained in Pennsylvania's plan, when combined with the control strategies being implemented in the other states that are part of the Philadelphia area, results in the improvement in the number of grid cell hours above the standard between 81-85 percent. This result satisfies the requirement of the second bench mark of the Statistical Test, described in EPA's alternative attainment test guidance cited earlier in this document. Additionally, the area design value in the base modeling period, when adjusted for the air quality improvement predicted in the attainment year by the local-scale modeling, results in a 2005 projected design value of 126 ppb. The local-scale modeling results are close enough to attainment to warrant the consideration of weight-of-evidence arguments that support the demonstration of attainment.

The Pennsylvania Phase II Plan provides weight-of-evidence arguments that corroborate further that it is likely the Philadelphia area will attain the 1-hour ozone standard by the statutory date of 2005. EPA developed design value adjustment factors based on regional scale modeling performed for the NOx SIP Call SNPR. PADEP used the adjustment factors to adjust the 1996 area design values. The analysis showed all area adjusted design values below 125 ppb. To provide additional information, PADEP applied EPA's design value adjustment factors to the 5-1997and 1998 area design values, resulting in all area design values below 124 ppb.

Because the Philadelphia area local modeling showed some peak concentrations above levels deemed consistent with attainment, EPA conducted an analysis to determine what additional emission reductions may be needed to support ozone attainment in the Philadelphia area. The EPA analysis determined that the Philadelphia area will need additional emission reductions of 3.4 tons per day of NOx and 62 tons per day of VOC to ensure attainment of the ozone NAAQS. This reduction is in addition to the NOx and VOC emission reductions that will be achieved from the Tier 2 rule. The additional VOC reductions may be achieved through NOx substitution in accordance with existing EPA guidance. PADEP ozone plan contains an enforceable commitment to adopt whatever rules are necessary to attain the 1-hour NAAQS for ozone.

Based on the results of the local scale modeling along with the additional weight-of-evidence arguments provided in the Pennsylvania Phase II plan, EPA believes that PADEP has successfully demonstrated attainment of the 1-hour ozone standard for the Philadelphia area by the 2005 statutory date.

VII. Recommendations

A. Proposed Approval

EPA is proposing to approve the Commonwealth of Pennsylvania's attainment demonstration SIP revision which was submitted on April 30, 1998 for the Philadelphia area if the following actions occur in accordance with the schedules stated in the NPR for this action:

(1) Pennsylvania adopts and submits an adequate motor vehicle emissions budget.

(2) Pennsylvania submits a list of control measures that, when implemented, would be expected to provide sufficient additional emission reductions to attain the standard. The Commonwealth need not commit to adopt any specific measures on their list at this time, but if they do not do so, they must identify sufficient additional emission reductions to attain the standard with the submitted motor vehicle emissions budget. These measures may not involve additional limits on highway construction beyond those that could be imposed under the submitted motor vehicle emissions budget.

(3) Pennsylvania adopts and submits a rule(s) for the regional NOx reductions consistent with the modeling demonstration.

(4) Pennsylvania adopts and submits an enforceable commitment, or reaffirmation of existing enforceable commitment to do the following:

> a) Submit measures by 10/31/01for additional emission reductions as required in the attainment demonstration test. For additional emission reduction measures developed through the regional process, the State must also submit an enforceable commitment for the additional measures and a backstop commitment to adopt and submit intrastate measures for the emission reductions in the event the OTR process does not recommend measures that produce emission reductions.
>
> b) Submit a revised SIP & motor vehicle emissions budget by 10/31/01 if additional measures affect the motor vehicle emissions inventory.
>
> c) Submit revised SIP & motor vehicle emissions budget 1 year after MOBILE6 issued.
>
> d) Perform a mid-course review.

B. Proposed Disapproval-in-the-Alternative

EPA is also proposing, in the alternative, to disapprove this SIP revision, if any of the actions above, do not occur in accordance with the schedules stated in the Notice of Proposed Rulemaking for this action.

REFERENCES

Cox, W.M. and S.Chu. 1996. *Assessment of Interannual Ozone Variation in Urban Areas from a Climatological Perspective.* **Atmospheric Environment**, 30, pp.2615-2625.

Guideline for Regulatory Application of the Urban Airshed Model, EPA- 450/4-91-013, July 1991.

Guidance on the Use Of Modeled Results to Demonstrate Attainment of the ozone NAAQS. EPA- 454/B-95-007, June 1996.

Guidance for Implementing the 1-Hour Ozone and Pre-Existing PM-10 NAAQS, Richard D.Wilson, OAR, AA, December 1997, Memorandum.

ATTACHMENT 1.

Procedures for Estimating

the Impact of Regional Strategies

on County-Specific Ozone Design Values

Procedures for estimating the Impact of Regional Strategies on County-Specific Ozone Design Values

The following procedures were used to estimate the effects of regional strategies on 1-hr county-specific ozone design values.

Step 1: Calculate Ambient Design Values

(a) For each monitor in a county determine the monitor specific 1-hr design values by taking the 4th highest daily maximum value from ozone data collected at the monitoring site for the period 1994-1996.

(b) Select the highest design value from all monitors within the county as the county-specific design value.

Step 2: Generate Model Predictions for three OTAG Episodes (July 1991, 1993 and 1995) for the following two scenarios

(a) Base Year model predictions reflecting emissions levels in the 1994-1996 time period.

(b) Regional Strategy model predictions reflecting a future year strategy scenario (e.g., state-specific budgets in the NO_X SIP Call).

Step 3: Calculate an Adjustment Factor for each Grid Cell

Notes:

(1) The adjustment factor is based on the percent difference in ozone predictions between the Base Year and the Regional Strategy. These factors will be used in Step 5 to "rollback" ambient design values to reflect the impacts of the regional strategy.
(2) Step 3 must be followed separately for the Base Year scenario and the Regional Strategy.

For each grid cell:

(a) Calculate daily maximum ozone concentrations for every day simulated (excluding 1st two-three days of each episode) for the three OTAG episodes identified in Step 2.

(b) For each episode select the 1st, 2nd, and 3rd highest daily maximum values

© For each of these "ranks" (i.e., 1st, 2nd, and 3rd ranked values), average the concentrations across the episodes (e.g., sum all 1st ranked values and divide by number of episodes). This yields an average value for each rank (i.e., average of the highest concentrations, average of 2nd highest, and average of the 3rd highest values).

(d) For each of the average ranks, calculate the percent difference in ozone between the Base Year scenario and the Regional Strategy. As an example of the equation for the highest ranked value:

$$PD_1 = [(avgR_1 - avgB_1) / avgB_1]^* 100$$

Where: PD_1 is the percent difference for highest value
$avgR_1$ is the average of highest value for Regional Strategy
$avgB_1$ is the average of highest value for Base Year

This yields a percent difference in each grid for the highest, a percent difference for the 2nd highest, and a percent difference for the 3rd highest values.

(e) Calculate the mean of the percent differences (i.e., sum the percent difference calculated for the 1st, 2nd, and 3rd highest values and divide by 3)

$$ADJ_g = (PD_1 + PD_2 + PD_3) / 3$$

Where: ADJ_g is the adjustment factor for the grid cell

Step 4: Assign Grid Cell Adjustment Factors to Individual Counties

(a) A grid cell's adjustment factor is assigned to a county based on the relative portion of the grid cell area covering the county. The grid with the largest fraction of area in a county is assigned to that county.

(b) For counties that completely contain more that one grid cell, the grid cell with the highest Base Year predicted concentration is assigned to that county.

© The step of assigning a unique grid cell to each county yields the county-specific adjustment factor. Note that only one grid cell is assigned to a county. Thus, there is no spatial averaging or spatial weighting of adjustment factors using multiple grid cells in determining the county-specific factors.

Step 5: Rollback Ambient Design Value

Note:
This step adjusts the ambient design values in each county to reflect the ozone reductions estimated to result from the Regional Strategy.

(a) Multiply the county-specific ambient design value, from Step 1, times the county-specific adjustment factor from Step 4, using the following equation:

:

$$DV_R = DV_A \times (1 + ADJ_c / 100)]$$

Where, DV_R is the design value after adjustment for the Regional Strategy,

DV_A is the ambient design value, and

ADJ_c is the adjustment factor for the county

Note: Estimates of which counties come into attainment are calculated based on a "roll-back" of county-specific Design Values. The Design Values are derived from three years of ambient measurements. The "roll-back" factors are based on the reduction in ozone (base year versus control strategy) predicted by a regional scale model during 3 ozone episodes. This information is useful for comparing the relative air quality improvements of alternative control options and for supplementing other analyses. The results may not be sufficient for an urban-scale attainment demonstration in all situations; therefore, States may choose to do additional modeling/analysis.

ATTACHMENT 2.

Bill Hunt Memorandum

INTEROFFICE MEMORANDUM

Date: 10-Jul-1998 04:21pm EST
From: BILL HUNT
RTPMAINHUB.HUNT-BILL@r3mime.r·
Dept:
Tel No:

TO: See Below

Subject: NOX SIP Call for Regional Modeling to Supplement 1-Hour SIP's

** High Priority **

I am providing the Regional Air Directors for Regions 1 through 7 and their staff with information needed to complete the 1-hour SIP's. EPA has agreed that the NOX SIP Call regional modeling may be used as part of the weight of evidence information to support the States selection of emissions reduction targets in the attainment demonstration. The purpose of this transmittal is to provide you and your staff with information on how to access and use these data. The website location from which the NOX SIP Call data both emissions and model outputs may be downloaded through file transfer protocol (FTP) access is ftp://www.epa.gov/pub/scram001/modelingcenter/. Two files with additional information are attached to this message. The file, rollback.wpd, in WordPerfect 6.1 format, contains a description of the methodology used to interpret the impact of the modeled strategy on county-specific ambient design values. The file, 1-hour.wk4, in Lotus1-2-3 Release 5 spreadsheet format, is a listing of the 1-hour ambient county design values (1994-1996) within the regional modeling domain along with the projected change in these design values when the NOX SIP Call control measures are applied.

Please share this information with your States. Feel free to call or e-mail Ellen Baldridge, if you have any questions or concerns about accessing the data and using it to supplement the States current analyses.

ATTACHMENT 3.

1994-1996 1-Hr Adjusted Design Values
Based on SNPR Budget Modeling

Rev 3-6-98

1994 - 1996 1-Hr Ambient Design Values and

Adjusted" Design Values Based on SNPR Budget Modeling

FIPs State	Cnty			Ambient 1994-96	SNPR Budget Run
10	1	Delaware	Kent	115	95
10	3	Delaware	New Castle	134	110
10	5	Delaware	Sussex	109	93
24	3	Maryland	Anne Arundel	151	133
24	5	Maryland	Baltimore	130	111
24	9	Maryland	Calvert	97	82
24	13	Maryland	Carroll	115	93
24	15	Maryland	Cecil	139	115
24	17	Maryland	Charles	109	90
24	19	Maryland	Dorchester	117	99

24	25	Maryland	Harford	140	121
24	29	Maryland	Kent	111	95
24	31	Maryland	Montgomery	119	100
24	33	Maryland	Prince Georges	134	119
24	510	Maryland	Baltimore City	137	125
34	1	New Jersey	Atlantic	110	93
34	3	New Jersey	Bergen	121	107
34	7	New Jersey	Camden	127	109
34	11	New Jersey	Cumberland	105	86
34	13	New Jersey	Essex	115	98
34	15	New Jersey	Gloucester	125	108
34	17	New Jersey	Hudson	120	111
34	19	New Jersey	Hunterdon	113	96
34	21	New Jersey	Mercer	134	113
34	23	New Jersey	Middlesex	139	121
34	25	New Jersey	Monmouth	130	108
34	27	New Jersey	Morris	125	106
34	29	New Jersey	Ocean	138	117
34	39	New Jersey	Union	109	94
42	1	Pennsylvania	Adams	112	92

42	3	Pennsylvania	Allegheny	133	118
42	7	Pennsylvania	Beaver	107	99
42	11	Pennsylvania	Berks	114	96
42	13	Pennsylvania	Blair	110	87
42	17	Pennsylvania	Bucks	137	117
42	21	Pennsylvania	Cambria	100	81
42	27	Pennsylvania	Centre	106	88
42	43	Pennsylvania	Dauphin	113	95
42	45	Pennsylvania	Delaware	124	106
42	47	Pennsylvania	Elk	95	78
42	49	Pennsylvania	Erie	107	92
42	55	Pennsylvania	Franklin	113	91
42	69	Pennsylvania	Lackawanna	110	96
42	71	Pennsylvania	Lancaster	116	99
42	73	Pennsylvania	Lawrence	101	91
42	77	Pennsylvania	Lehigh	111	97
42	79	Pennsylvania	Luzerne	105	86
42	81	Pennsylvania	Lycoming	87	74
42	85	Pennsylvania	Mercer	111	99
42	91	Pennsylvania	Montgomery	118	98

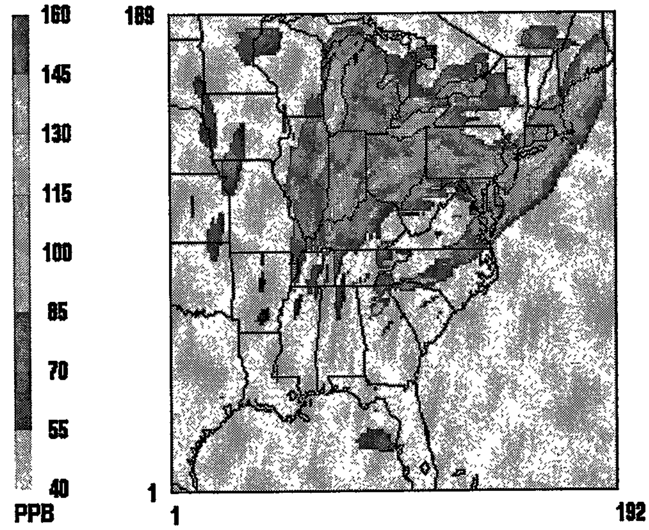
42	95	Pennsylvania	Northampton	116	97
42	99	Pennsylvania	Perry	103	85
42	101	Pennsylvania	Philadelphia	130	116
42	111	Pennsylvania	Somerset	109	82
42	125	Pennsylvania	Washington	112	88
42	129	Pennsylvania	Westmoreland	119	98
42	133	Pennsylvania	York	105	87

ATTACHMENT 4.

Model-Predicted Peak Ozone Concentrations from OTAG Run 2 and Run 5 for July 20, 1991

Daily Peak Ozone (Strategy Run 2)

Strategy Run 2 = Level 3 controls all sectors
OTAG — Midwest Modeling Center

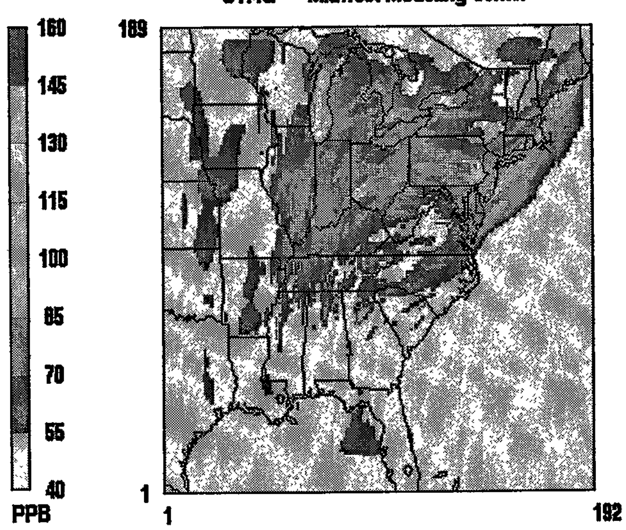


July 20,1991 0:00:00
Min=-999 at (1,1), Max= 144 at (171,151)

PAVE by MCNC

Daily Peak Ozone: Run 5

Run 5 = Lev 3 Util. NOx, Lev 1 non-Util NOx, Lev 1 Area, Lev 0 Motor V
OTAG — Midwest Modeling Center



July 20,1991 0:00:00
Min=-999 at (1,1), Max= 151 at (171,151)

ATTACHMENT 5.

Improving Weight of Evidence Through Identification of Additional Emission Reductions Not Modeled

DRAFT - Guidance for Improving Weight of Evidence Through Identification of Additional Emission Reductions, Not Modeled

by
U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emissions, Monitoring, and Analysis Division
Air Quality Modeling Group
Research Triangle Park, NC 27711

October 1999

Each of the methods described in the remainder of this paper begins with a monitored ozone concentration which can be extrapolated to the attainment year and compared with the standard. If the attainment year concentration is over 124 ppb, the methods described in this paper can be used to estimate what would constitute "substantial" additional emission reductions needed to support a weight of evidence argument for attainment. The differences among the methods lie in the factors used for this extrapolation. These are summarized in Table 1.

Both methods are based on the assumption that we can estimate the relationship between ozone and its precursors (VOC and NOx). We can estimate this relationship by either (1) comparing changes in model predicted ozone to changes in modeled emissions or (2) comparing changes in observed air quality to changes in emissions. Both methods for estimating a relationship are equally valid. Both have inherent uncertainty in estimates of emissions inventories and estimates of the change in ozone air quality. Utility of either method is dependent on the availability of data which shows a response in ozone due to a decrease in VOC and NOx emissions. For example, if an area wants to apply method 2 using the NET inventories for the 1990 and 1996 reference years, the VOC and NOx totals for the nonattainment area must show a decrease in VOC and NOx between 1990 and 1996. If this is not the case then use of the NET data for those two reference years in not appropriate.

Table 1. Summary of Methods for Estimating Additional Emission Reductions

Method	Ozone Concentration Being Extrapolated	Extrapolation Ratio (normalized reduction factor)
1	Future Air Quality Design Value	$\frac{\text{Change in emissions From base to attainment year}}{\text{Change in modeled concentration}}$
2	Future Air Quality Design Value	$\frac{\text{Change in emissions From base to the present year}}{\text{Change in monitored concentration}}$

Estimate a Future Air Quality Design Value

Both methods make use of the results of past modeling to derive a modeled response of ozone design values to VOC and NOx controls to estimate a future air quality design value. Relative reduction factors are derived and used similarly to what is described in U.S. EPA, (1999), *Draft Guidance on the Use of Models and Other Analyses In Attainment Demonstrations for the 8-Hour Ozone NAAQS*, EPA-454/R-99-004. If the estimated future design value is < 124 ppb, no additional emission reductions are needed to strengthen the weight of evidence argument for attainment.

(1) Calculate an average (over all modeled days) predicted daily maximum (domain wide) 1-hour ozone concentration, first with the base emissions (e.g., 1990) and then with the future emissions (e.g., 2007).

(2) Using results from step 1, calculate the relative reduction factor in the modeling domain, RRF, by taking the ratio of the average daily maximum 1-hour ozone concentration obtained with future emissions to that obtained with the base emissions.

$$RRF = AVGf / AVGc \qquad (1)$$

where

AVGf = average (across all days) predicted daily maximum 1-hour ozone concentration for future emissions, ppb.

AVGc = average (across all days) predicted daily maximum 1-hour ozone concentration for base emissions, ppb.

(3) Calculate the base design value, DVB, as the average of 3 nonattainment area ozone design values that represent the period used to predict ozone for base emissions (e.g., if 1990 emissions

are used, average design values for 1990, 1991 and 1992)[7]. The nonattainment area ozone design value is the maximum monitored design value from all sites in the nonattainment area.

(4) Estimate the future design value, DVF, for the nonattainment area as the product of the relative reductions factor (step 2) and the base design value (step 3). If the future design value is < 124 ppb additional emission reductions can not be estimated and may not be needed, no additional steps are required. If the future design value is > 124 ppb proceed to the next step.

Example 1: Estimate Future Air Quality Design Value

Given: Past results from modeling indicate predicted peaks (for three days) before controls in 1990 are 195, 180, and 165 ppb and after controls in 2007 are 155, 150 and 145 ppb. There are two monitor sites in the nonattainment area. The monitored air quality design values for each site are 185 and 176 in 1990, 145 and 152 in 1991, and 155 and 140 in 1992.

Find: Estimate the future air quality design value in 2007.

Solution:

(1) Compute the base and future average 1-hour daily maximum concentration. The average of the model predicted peaks (in and downwind of the nonattainment area) for the base before controls is: (195 + 180 + 165) / 3 = 180 ppb and for the future after controls is: (155 + 150 + 145) / 3 = 150 ppb.

(2) Using the results in step 1 the relative reduction factor is: 150/180 = 0.83.

(3) Determine the nonattainment area design values representative of the episode used in the base emissions and calculate the base design value. The nonattainment area design value for 1990 is MAX(185, 176) = 185, for 1991 is MAX(145, 152) = 152, and for 1992 is MAX (155, 140) = 155 ppb. The base ozone design value is (185 + 152 + 155) / 3 = 164 ppb.

(4) The estimated future design value is (0.83) (164) = 136 ppb

This is > 124 ppb, so we need to apply the following methods to determine additional emission reductions.

[7]Note, 1990, 1991 and 1992 design values reflect observations for 1988-90, 1989-91, and 1990-92, respectively. All of these periods include "1990", the year of the base emissions.

Method 1: Estimate Additional Emission Reductions Using Modeled Responses

Method 1 uses the change in nonattainment area monitored base ozone design value and estimated future ozone design value along with changes in modeled emissions before controls (base emissions) and after controls (future emissions) to estimate additional emission reductions.

(1) Calculate the change in air quality design value by subtracting the estimated future design value (e.g., 2007) from the base air quality design value (e.g., 1990). Estimate the percent reduction in NOx emissions and VOC emissions which occurred within the nonattainment area before and after controls. Do not include biogenic emissions. Divide the percent reduction in NOx emissions by the change in the air quality design value and divide the percent reduction in VOC emissions by the change in the air quality design value. This step results in two "normalized emissions reduction factors", one for changes in NOx emissions and one for changes in VOC emissions.

(2) Estimate the amount of additional ozone reduction needed by taking the difference between the future design value and 124 ppb, the maximum ozone design value consistent with meeting the NAAQS.

(3) Calculate additional necessary emission reductions by taking the product of each of the "normalized" emissions reduction factors (step 1) and the amount of ozone reduction needed (step 2).

<u>Example 2: Calculate reduction factor using model predictions and apply to model estimated future design value</u>

Given: Results from modeling used in Example 1 indicate an estimated future design value is 136 ppb and the monitored air quality ozone base design value representative of the nonattainment area is 164 ppb. The control strategy reflects a 30% reduction in VOC and a 35% reduction in NOx emissions. These reductions were obtained by comparing the modeled 1990 base emissions to the modeled 2007 attainment year emissions for the nonattainment area.

Find: The amount of additional VOC and NOx reduction needed to reduce the model estimated future design value to 124 ppb, so that a convincing weight of evidence argument can be made that unmodeled emission reductions are substantial.

Solution:

(1) Calculate the change in air quality design value as 164 - 136 = 28 ppb. The estimated percent reduction in VOC and NOx are given 30% VOC and 35% NOx. The "normalized emission reduction factors" for VOC is 30% / 28 = 1%/ ppb and for NOx is 35% / 28 = 1.2%/ ppb.

(2) The amount of additional reduction needed is (136 - 124) = 12 ppb.

(3) Therefore, the additional reduction needed in VOC is (1%) (12) = 12% of the VOC emissions. And, the additional reduction needed in NOx emissions is (1.2%) (12) = 14% of the NOx emissions.

Method 2: Estimate Additional Emission Reductions Using Observed Air Quality Changes

This method uses monitored ozone air quality design values and emissions estimates for the nonattainment area to calculate the "normalized emissions reduction factors" for VOC and NOx. These reduction factors are then applied to the model estimated future design value as calculated in Example 1 to estimate additional emission reductions.

(1) Calculate the percent reduction in NOx emissions and VOC emissions which occurred within the nonattainment area from an earlier year (e.g., 1990) to a more recent year (e.g., 1996). The National Emissions Trends (NET) inventory provides an example of these data. Do not include biogenic emissions.

(2) Calculate the change in the nonattainment area's ozone design value using the same reference years. To account for fluctuations in meteorology average three years of design values to estimate the design value for each of the reference years. The nonattainment area average design values are used to assess the observed change in air quality from the "early" time period to a "recent" time period. Monitors that were only online during one of these periods may not be representative of the actual change in air quality. Rationale for excluding a monitor should be documented.

(3) Divide the percent reduction in NOx emissions by the change in the area's ozone design value. Divide the percent reduction in VOC emissions by the change in the area's ozone design value. This step gives two "normalized emissions reduction factors", one for changes in NOx emissions and one for changes in VOC emissions.

(4) Calculate the additional amount of ozone reduction needed by subtracting 124 ppb from the model estimated future design value (see Example 1).

(5) Calculate additional necessary emission reductions by taking the product of each of the "normalized" emissions reduction factors (step 1) and the amount of ozone reduction needed (step 2).

<u>Example 3: Calculate reduction factor using change in ozone air quality design values and nonattainment area emissions, and apply to model estimated future design value</u>

Given: There are two monitors in the nonattainment area. The monitored air quality design values for each site for reference years 1990 and 1996 are presented in Table 2. Emission reductions between 1990 and 1996 are 30% reduction in VOC and a 35% reduction in NOx emissions. These reductions were obtained by comparing the 1990 NET inventory to the 1996 NET inventory for the nonattainment area. The model estimated future design value in 2007 is 136 ppb.

Table 2. Air Quality Design Values (ppb)						
Monitor	1990 Reference Year			1996 Reference Year		
	1990	1991	1992	1996	1997	1998
1	185	145	155	140	146	139
2	176	152	140	135	145	130

Find: The amount of additional VOC and NOx reduction needed to reduce the future design value to 124 ppb, so that a convincing weight of evidence argument can be made that the unmodeled emission reductions are substantial.

Solution:

(1) The estimated percent reduction in VOC and NOx are given 30% VOC and 35% NOx.

(2) Calculate the change in the nonattainment area's ozone design value. Determine the design value for each reference year by first taking the maximum design from the two sites for each of three years and then averaging the three years design values. The nonattainment area's ozone design value for 1990 is (185 + 152 + 155) / 3 = 164 and for 1996 is (140 + 146 + 139) / 3 = 142 ppb. The change in air quality design value as 164 - 142 = 22 ppb.

(3) The "normalized emission reduction factors" for VOC is 30% / 22 = 1.36%/ ppb and for NOx is 35% / 22 = 1.59%/ ppb.

(4) The amount of additional reduction needed is (136 - 124) = 12 ppb.

(5) Therefore, the additional reduction needed in VOC is (1.36%) (12) = 16% of the VOC emissions. And, the additional reduction needed in NOx emissions is (1.59%) (12) = 19% of the NOx emissions.

Incorporate Tier 2 and other unmodeled control measures

Once the percent reductions for VOC and NOx have been determined they can be converted into tons per day reductions. Control measures used to address these additional reductions must be quantified as estimates in tons per day reductions and compared to the level of additional reductions needed. Sufficient additional measures have been identified when the total from all unmodeled controls are equal to or greater than the estimated additional reductions.

(1) Convert the estimated percent reduction in VOC and NOx to tons per day by taking the product of the percent reduction and the total emissions in the base case inventory for each category of emissions, VOC and NOx. This results in tons per day for VOC and tons per day for NOx. These are the additional level of controls needed.

(2) Subtract the Tier 2 emission reduction estimates being applied towards attainment from the additional level of controls for each category of emissions, VOC and NOx. All other unmodeled controls should be subtracted as well. Repeat this step until no additional reductions remain.

Example 4: Adjust additional emission reductions to account for Tier 2

Given: The nonattainment area total emissions in 1990 for VOC and NOx are 1197 tpd and 927 tpd, respectively. Also, as shown in Table 3 the estimated Tier 2 reductions in VOC and NOx are 10 tpd and 25 tpd, respectively. The estimated additional emission reductions are 16% VOC and 19% NOx, as calculated in example 3.

Table 3: Nonattainment Area Emissions Summary (tpd) without Tier 2

Year	VOC				NOx			
	Point	Area	Mobile	Total	Point	Area	Mobile	Total
1990	400	447	350	1197	300	377	250	927
2007	241	282	200	723	150	312	125	587
Estimated Tier 2 Reduction =				10				25

Find: What are the additional emission reductions in tons per day still needed after incorporating Tier 2?

Solution:

(1) The additional reductions are (.16 * 1197 tpd) = 192 tpd for VOC and (.19 * 927) = 176 tpd for NOx.

(2) After subtracting Tier 2 reductions the remaining reductions are (192 - 10) = 182 tpd for VOC and (176 - 25) = 151 tpd for NOx.

Use of Results

The results from both methods should be considered along with other weight of evidence presented in the technical analyses for the attainment demonstration. For example, where model predicted peaks show greater improvement when low level NOx emissions are reduced verses VOC or elevated NOx, substituting an equal amount of low level NOx reductions for the VOC reductions is acceptable. Also, where modeling demonstrates substantial improvements in model predeicted peaks when emission reductions are applied to adjacent counties, the area of controls may be extended to include adjacent counties. However, if emissions from adjacent counties are used they must be included in the total emissions for the base case. Modeling the additional emission reductions would normally address these two example as well as the following: change in boundary conditions due to transport, location of emissions (such as point, area or mobile), elevated vs low level emission reductions, chemistry and wind flow patterns.

Model sensitivity runs may be used to help identify the appropriate controls measures to fill the additional emission reductions needed to provide for attainment in the weight of evidence analyses.

For guidance on VOC and NOx substitution use the, "NOx Substitution Guidance", EPA 1993; "Transmittal of NOx Substitution Guidance", memorandum from John Seitz, 1993; "Clarification of Policy for Nitrogen Oxides (NOx) Substitution", memorandum from John Seitz, 1994; and "Guidance for Implementing the 1-Hour Ozone and Pre-Existing PM10 NAAQS", memorandum from Richard D. Wilson, 1997. The 1993 and 1994 guidance was primarily designed for the post-1996 rate of progress (3%/year VOC reduction) requirement and allowed NOx reductions to be substituted for the otherwise mandatory VOC reductions as long as the NOx reductions were shown to be consistent with the attainment demonstration (in other words, if the attainment demo relied only on VOC reductions, the area could not substitute NOx reductions for the 3%/year requirement, and if the attainment demo relied on both VOC & NOx reductions, NOx could be substituted in part). The 1994 guidance document (Guidance on the Post-1996 Rate-of-Progress Plan and the Attainment Demonstration, EPA-452/R-93-015, Jan. 1994) provided equations & procedures for calculating the amount of NOx reductions that could be substituted for VOC for the rate of progress requirements. Also, the 1997 guidance establishes the 100 & 200 km distances for substitution of emission reductions outside the nonattainment area. These documents are located on the EPA website: "www.epa.gov/ttn/oarpg/t1pgm.html".

PHILADELPHIA NON-ATTAINMENT AREA 1 HR ATTAINMENT ADDITIONAL EMISSION REDUCTION ANALYSIS

DATA SHEET

Philadelphia AREA 1 HR DESIGN VALUES

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
D.V.	161	180	187	187	152	153	156	140	146	137	137	129

MODEL PREDICTED PEAK OZONE CONCENTRATIONS

Episode Day	Modeled Peak Base Case	Modeled Peak 2005 Control Case
07/19/91	156 ppb	138 ppb
07/20/91	190 ppb	149 ppb
Average	173 ppb	143.5 ppb

1. Reltative Reduction Factor (RRF)= 149.3 ppb/180.3 ppb = .83
2. 1991 Base Modeling Period Design Value = 152 ppb + 153 ppb + 156 ppb / 3 = 153.6 ppb
3. 2005 Design Value = Base Period Design Value * RRF = 153.6 ppb * .83 = 127.9 ppb
4. Air Quality Shortfall = 127.9 ppb - 124 ppb = 3.9 ppb
5. 1996 Design Value = 137 ppb + 137 ppb + 129 ppb / 3 = 134 ppb* * The Cecil County Maryland monitor was not used to compute the 1996 design value because it was not in operation during the 1990 base period.

PHILADELPHIA AREA EMISSIONS FOR METHOD 2:

Pollutant	1990 NET Emissions (T/Day)	1996 NET Emissions (T/Day)	% Emission from 1990-1996
NOx	1011	883	12.7
VOC	1380	1050	23.9

ADDITIONAL EMISSION REDUCTIONS METHOD 2:

Pollutant	Emission Reduction Factor (%/ppb)	Percent Additional Reduction from 1990 Levels	Additional Reduction (T/Day)
NOx	.6	2.5	25.4
VOC	1.2	4.8	65.6

EFFECT OF ADDITIONAL EMISSION REDUCTIONS FROM TIER 2 USING METHOD 2

Pollutant	2005 Tier 2 Reduction (T/Day)	Emission Reduction Factor (%/ppb)	Percent Additional Reduction from 1990 levels	Additional Reduction (T/Day)
NOx	22	.6	.3	3.4
VOC	3.8	1.2	4.5	61.8